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ABSTRACT

Human beings who have been forced to acquire language through non-auditory modalities characteristically display an impoverished syntactic system. I.M. Schlessinger (1970) has shown, for example, that users of sign language have difficulty in communicating syntactic relations such as "subject of main verb," "object of the verb," and "indirect object." The major hypothesis under investigation in the study reported here is that a significant, though not total, congenital hearing impairment should result in an inability to handle complex aspects of syntax in the comprehension of sentences. Twenty hard-of-hearing children were used (13 males and 7 females, ages 9.5 to 19.4 years) all regular students in the Duval County, Florida, public school system. Each subject heard and saw twenty sentences, and was asked to point to one of four accompanying pictures which most accurately depicted the events described in a given sentence. Twenty trials were run at a single session for each subject. Results appear to verify the hypothesis, and it is further suggested that the hard-of-hearing language user may, perhaps in order to compensate for the syntactic deficit, rely heavily on probabilistic strategies in comprehension. (Author/CLK)

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COMPREHENSION OF DOUBLE-OBJECT CONSTRUCTIONS BY HARD-OF-HEARING SUBJECTS

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Introduction

Human beings who have been forced to acquire language through non-auditory modalities characteristically display an impoverished syntactic system. I. M. Schlessinger (1970) has shown that users of sign language have great difficulty in communicating syntactic relations such as "subject of the main verb," "object of the verb," and "indirect object." Written English of adolescent deaf shows abundant errors in the use of articles, in number agreement, verb tense and aspect, and other errors in the use of syntactic formatives (Myklebust, 1965). Studies of the spoken language of the deaf have also revealed syntactic deficits (Brannon, 1968; Cooper, 1967; Power and Quigley, 1973).

Studies of syntactic comprehension in hard of hearing subjects are rare. Wilcox and Tobin (1974) employed a repetition task to investigate syntactic patterns in ten hard of hearing children. The experimental group showed significantly lower means in each grammatical form than the normal hearing controls. Pressnell (1973) used the Northwestern Syntax Screening Test in a study of normal and hearing impaired (mean loss of hearing was 80 dB) children aged 5 to 13. The hearing impaired did poorer on this test than normal controls and the e was significantly less improvement over ages in the hearing impaired than in the normals.

In this paper, we report the results of an experiment designed to show how much of an effect hearing impairment has on the acquisition of an important part of English syntax -- the comprehension of the direct and indirect objects of sentences.

Normal Acquisition of Double-Object Constructions

The syntax of English allows for two forms of sentences having both a direct and an indirect object (except in the case where the direct object is a pronoun). For a sentence having the indirect object following the direct object and marked by the dative marker "to" (as, for example), "He gave some flowers to the girl") there is a synonymous alternate with the indirect object preceeding the direct object and no dative marker ("He gave the girl some flowers.") (But notice that if the direct object is a pronoun; e.g., "He gave them to the girl", the alternate is not grammatical - * "He gave the girl them").

Using the technique of asking children to carry out commands,

Stayton (1972) found that three- and four-year-old children understood the "to" forms of indirect-direct object sentences (e.g., "Show the doggy to the dolly") but not the alternative expressions (e.g., "Show the dolly the doggy"). Consequently, the acquisition of the ability to comprehend the indirect plus direct object form of sentences occurs later in life than many other aspects of language acquisition.

Stayton's work clearly showed that the problem encountered by the children was a syntactic one: the ability to perform well on the "to" forms showed that the children understood the major lexical items involved (e.g., "doggy", "dolly") as well as the semantics of dative and accusative (i.e., they demonstrated a comprehension of the notion of someone doing something involving both the thing that was given and the syntactic problem of assigning functional status to the two noun phrases in the marked (the indirect-direct object order) form. Scholes, Tanis, and Turner (In press) studied the acquisition of the comprehension of the marked form in children five and older.

In order to gain rigor and to provide for the differentiation of errors made for different reasons, Scholes et al., used a picture-verification task and a set of sentences modeled after a reading study by Mehler, Bever, and Carey (1967). In these sentences, said to be "superficially ambiguous", three elements occur in the predicate such that the assignment of these three elements to the two constituents, indirect and direct object, is not clear. In a sentence such as "They fed her dog candies," it is not possible, on visual inspection or on hearing a "flat" reading to know whether they fed dog biscuits to some female or they fed biscuits to some female's dog (there is a third reading in which the dog's name is "Candies" but that is not relevant here). Such ambiguous sentences are easily disambiguated by the insertion of an article "they fed her dog the candies")- "they fed her the dog candies") or by appropriate disjuncture (pause and/or stress) cues. Let us call the reading of such a sentence in which the last two elements ("dog" and "candies", in the example) are assigned to the direct object the B Reading, and the alternative (in which only the last nominal element is assigned to the direct object) the A Reading. Now, if a subject is shown pictures appropriate to these two readings and pictures inappropriate to either reading (but appropriate for some other set of sentences) and he is presented with, say, the B Reading form and asked to point to the appropriate picture, he may point to the correct picture or he may point to the picture appropriate to the A Reading (a syntactic error) or he may point to an inappropriate picture (a lexical error).

In the work of Scholes et al on normals, the A and B Reading forms of sentences as well as the ambiguous forms were employed with a four-picture, picture-verification task. Inappropriate responses (i.e., lexical errors) were essentially non-existent, but the error rate for syntactic errors changed systematically across seven age groups of twenty subjects each. The percent of correct responses for the age groups is plotted in Figure 1. This work, then, established a developmental curve for the acquisition of the ability to correctly comprehend the marked form of indirect plus direct object predicates.

As mentioned above, these groups were also presented ambiguous forms of the sentences. In such cases, the subject's choice of the appropriate picture is made on the basis of extra-linguistic criteria (that is, there is nothing in the sentence itself which tells the subject which choice to make). In these cases, the subjects showed a preference for the B Reading interpretation, and this tendency changed systematically across the age groups. The percent of B Reading responses to ambiguous stimuli are shown in Figure 2.

For additional details and discussion see Scholes, Tanis, and Turner (In press), and Scholes (To appear).

Since both the correct comprehension of the unambiguous sentences and the choice interpretation of the ambiguous sentences showed systematic development as the age of the normal subjects increased, we felt that this instrument would be suitable for studying the effect of hearing loss on the acquisition of syntax and, as well, on the development of interpretive strategies for ambiguous sentences.

Methods

Subjects

Subjects for this study were twenty hard-of-hearing children (Davis and Silverman, 1960, 415) attending regular classes in the Duval County, Florida, public school system. There were thirteen males and seven females who ranged in age from 9.5 to 19.4 years with a mean age of 14.6 years. All subjects had significant hearing losses of 40 to 86 dB in the better ear (ANSI, 1969) in the 500 to 2000 Hz range. The average hearing loss was 62.6 dB with a standard deviation of 16.2. The group was of normal intelligence as measured by the WAIS or WISC Performance Tests. The average IQ score was 101.5 with a standard deviation of 16.1. Verbal ability as measured by the Standard Score on the Peabody Picture Vocabulary Test (PPVT) was well below normal. The average score was 71.2 with a standard deviation of 16.1. To the best of our knowledge hearing impairment was present at birth in this group of subjects. All subjects had been fitted with hearing aids between the ages of two and ten. The amount of time the aids were worn varied considerably within the group--from never to over nine hours a day. Subjects with the most severe hearing losses tended to wear the aids most; there was not, however, any correlation between the degree of hearing loss and the age at which the aid was fitted. Twenty-five percent of the subjects had attended a preschool for the hearing impaired for times ranging from two months to two years. Eighty-five percent had been enrolled in speech therapy programs, and half had at one time been enrolled in a full-time class for school-age hearing impaired children. Eighty percent had received special help from a resource teacher while attending classes with normal hearing students.

Stimuli

Fifteen sentences were used. Ten of these sentences were unambiguous and were used once each. Five of the sentences were ambiguous and were used twice each. Thus, twenty trials were run for each subject. The sentences used are shown in Table 1.

Accompanying each of the twenty (20) sentences was a line drawing depicting the event described by the sentence. Figure 3 displays four such drawings: drawings which could accompany, "he showed her baby the pictures", "he showed her the baby pictures", "he showed the boys' horse the shoes", or "he showed the boys the horse shoes."

Procedure

Each subject heard and saw twenty sentences (one instance of each of the ten unambiguous sentences and two instances of each of the five ambiguous sentences) presented in a single randomization. The auditory presentation was through air from a Concord TC-350 tape recorder; the visual presentation was by single sentences typed on 3 x 5 cards.

Concomitant with the visual and auditory presentation of each sentence, the subject was shown an 8½ x 11 array of four pictures, as in Figure 3. For each trial, the four pictures included the picture describing the A Reading of the trial sentence, the picture showing the B Reading of the trial sentence, and two pictures (chosen at random) showing the A Reading and B Reading from one of the other four sets of sentences. The spacial arrangement of the four pictures was randomized for each display.

For any one trial the subject heard and saw a stimulus sentence and saw an array of four pictures. He was asked to point to the picture depicting the events described in the sentences; i.e., point to the picture that "goes with" the sentence.

The twenty trials were run at a single session for each subject and the total time required for a single subject was generally less than thirty minutes. The subject was given as much time as he liked to respond.

The intercorrelations among the WISC/WAIS performance IQ, the PPVT IQ, hearing loss (dB), and the total correct on the Indirect/Direct Object Test were computed. Of the six possible correlations, the PPVT IQ was positively associated with the WISC/WAIS IQ ($r = 0.45$, $df = 19$, $p < .05$); the PPVT IQ was also positively correlated with the number of correct responses on the Indirect/Direct Object Test ($r = 0.71$, $df = 19$, $p < .01$).

Discussion

The major hypothesis under investigation here is that a significant, though not total, congenital hearing impairment should result in an

inability to handle complex aspects of syntax in the comprehension of sentences. This hypothesis was supported in that the hard-of-hearing subjects, who average 14.5 years of age, correctly comprehend the unambiguous sentences of our study in 59% of the trials. This figure is well below that of the normal hearing 13-year-old subjects' 91% correct (Figure 1) and compares most closely with the five-year-olds' performance in normals. For the ten trials involving unambiguous sentences, the average correct number of responses for the hard-of-hearing subjects was 5.90: with a standard deviation of 1.41 this means our hard-of-hearing subjects performed at chance level -- that is, they did not correctly comprehend these double object constructions.

A stronger form of this hypothesis would assert a correlation between the degree of hearing impairment and the performance on the Indirect/Direct Object Test for the group of subjects. This strong form of the hypothesis was not supported (the correlation was -0.22, not statistically significant).

It must be emphasized that the hard-of-hearing subjects' poor performance on the comprehension test was not due to their inability to hear the syntactic cues, since this group saw each sentence as well as heard it (the normal subjects only heard them). Thus, even when visually presented with a sentence such as "he showed her the baby pictures" these subjects could not distinguish it from "he showed her baby the pictures" to a significant degree.

Within the comprehension of the unambiguous sentences, the type of reading showed significantly different performance levels; the subjects' getting the correct answer more often when the sentence was of the B-Reading form than when it was the A-Reading form. The B-Reading of the example set shown earlier is "he showed her the baby pictures" and the A-Reading is "he showed her baby the pictures."

This "B-Reading Preference" also obtained for the normal subjects (Figure 2) and is referred to in the report of that study (Scholes, et al, In press) as the "B-Reading Bias." This bias increases systematically over the age groups in the study of normal children but is not present in the college-age subject group. If this bias were a function of the plausibility of the sentence readings or the pictures displayed we would expect the bias to hold reasonably constant over the age groups, and this is not the case. We conclude, therefore, that the changing bias is a reflection of one or more developing comprehensional strategies. Such strategies are, in general, non-linguistic probabilistic methods of arriving at a "most-likely" meaning of a sentence. For example, a strategy might be that the first noun phrase of any sentence is the subject of that sentence. In the case of the sentences employed in our study, the strategy could be stated: "given three nominal elements of a predicate, assign the last two to the direct object." Reliance on this strategy appears to increase during childhood, but get dropped by college age.

Since the B-Reading is the predominant choice of interpretation for the intentionally ambiguous sentences for the hard-of-hearing group, it is not surprising that this reading should be chosen most often in the case of the unambiguous sentences. The group's overall chance behavior on these unambiguous stimuli indicates that these sentences are functionally ambiguous to the subjects, and, therefore, they interpret them by the same strategies as are used for the intentionally ambiguous cases. In other words, since the subjects are not able to utilize the syntactic and acoustic cues for the comprehension of these sentences, they rely on the non-linguistic strategy of "most likely interpretation."

In the normal language user sentence comprehension is accomplished by both the utilization of the internalized grammar of the language and by the application of these probabilistic strategies (Scholes, 1972). Since these strategies are intended, basically, to allow the user to by-pass the complex operations of the syntax of the language, it is not surprising that they should be utilized by individuals in whom the syntactic component of language is not fully developed.

In summary, the results of our study appear to verify the hypothesis that a significant impairment of the hearing modality results in the acquisition of a syntactically impoverished form of language. In addition, it is suggested that the hard-of-hearing language user may, perhaps in order to compensate for the syntactic deficit, rely heavily on probabilistic strategies in comprehension.

A study in which this same test was applied to aphasics is reported in Heilman and Scholes (ms).

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Set	Ambiguous Form	A Reading Form	B Reading Form
1	He showed her girls hats	He showed her girls the hats	He showed her the girls hats
2	He showed her bird seed	He showed her bird the seed	He showed her the bird seed
3	He showed the boys lion tracks	He showed the boys lion the tracks	He showed the boys the lion tracks
4	He showed the boys horse shoes	He showed the boys horse the shoes	He showed the boys the horse shoes
5	He showed her baby pictures	He showed her baby the pictures	He showed her the baby pictures

Table I. Sentence stimuli.

Measure	Mean	SD
1. Indirect/direct object test		
A. Correct responses, A Reading Unambiguous	2.60	1.36
B. Correct responses, B Reading Unambiguous	3.30	1.31
C. A Reading responses, Ambiguous sentences	2.80	2.09
2. WISC/WAIS Performance	101.5	16.1
3. PPVT	71.2	16.1
4. Hearing Loss in dB	62.6	16.2

Table II. Means and standard deviations for relevant variables.

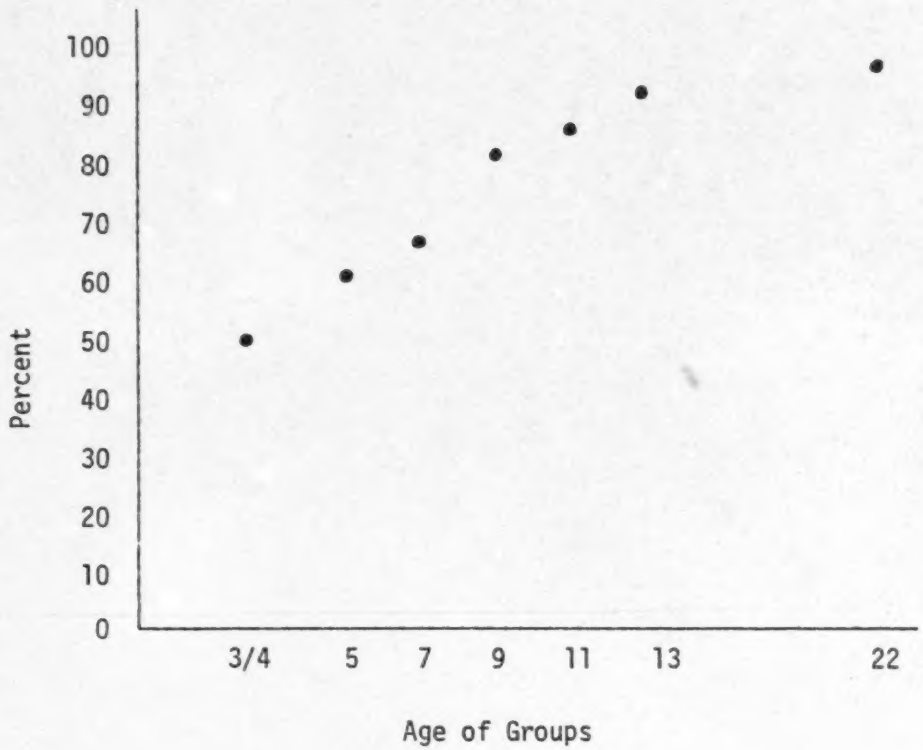

Figure 1. Mean percent of correct responses to unambiguous sentences by normal subjects. 3/4 data point from Stayton (1972).

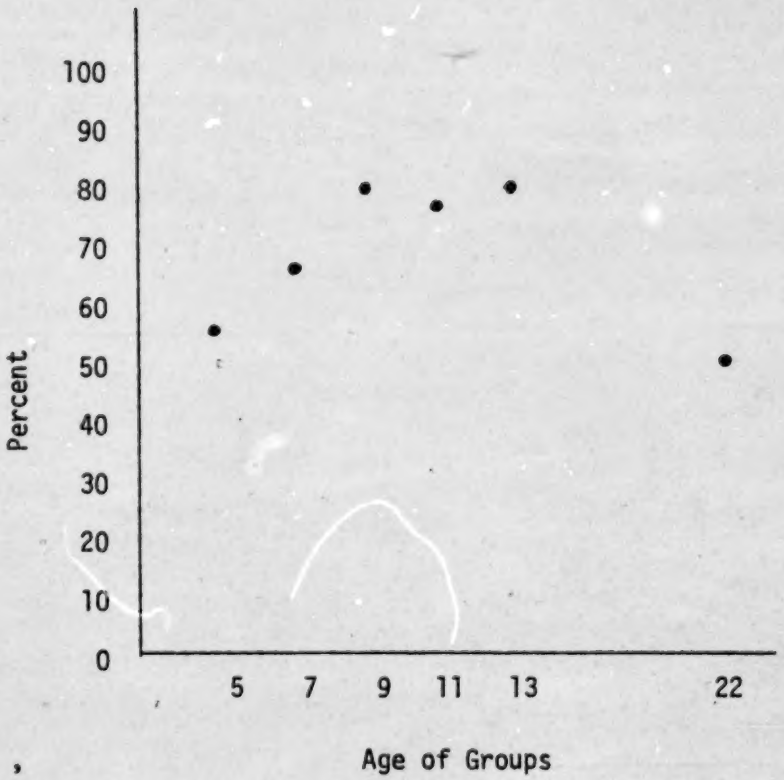

Figure 2: Mean percent of B-Reading responses to ambiguous sentences by normal subjects.

Figure 3. Sample page of line drawings